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Spontaneous Mirror-Symmetry Breaking in Different non-Chiral Liquid Crystalline Systems.

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Spontaneous Mirror-Symmetry and appearance of chiral self-assembled superstructures in non-chiral systems represents a fascinating field of contemporary research with potential applications. For long time the formation of helical superstructure was associated with enantiomeric chiral molecules. Later on Pasteur showed that that the racemic mixtures of chiral molecules can resolve spontaneously into two chiral forms. Such deracemization or symmetry breaking in racemic mixtures was observed during crystallization. In recent years interest in mirror-symmetry breaking extended to soft matter systems.

Recently mirror-symmetry breaking was observed even in non-chiral systems. Special progress in this field was made in achiral liquid crystalline phases formed by bent-core molecules which form two types of chiral conglomerates with opposite sign of spontaneous polarization [1] and very short pitch helical superstructures [2] which show fast electrooptic response and V-shape switching shown in Figure 1.

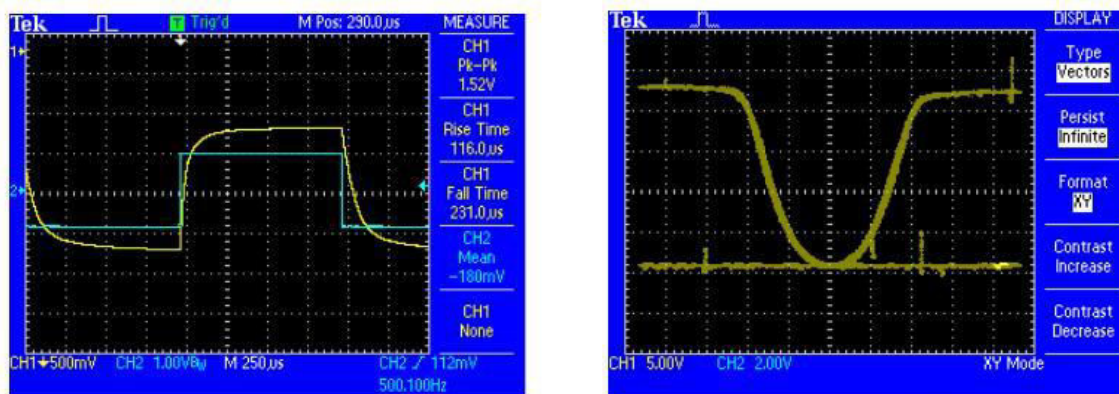


Figure 1. Oscilloscope screenshots of (a) linear ($\alpha=0$) and (b) quadratic (V-shape) ($\alpha=0$) electro-optical response of $8\mu\text{m}$ planar LC cell at 105°C

Later on mirror-symmetry breaking was observed in bent-shaped (or twist-bent) nematic dimers [3], which also form short pitch helices [4]. Finally the chiral separation was reported even in achiral isotropic liquids [5]. Herein we report recent results on symmetry breaking in different LC systems: bent-core smectics; twist-bent nematics; and even in de Vries SmA phase. The physical reasons for the symmetry breaking in these systems will be discussed.

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